SP-F5/7Evaluation of Fisheries Management on Project Fisheries

October 25, 2002

1.0 Introduction/Background

The Oroville Dam Facilities are comprised of the Fish Barrier Dam, the Thermalito Diversion Dam, and the Oroville Dam. Four major tributaries exist upstream of Lake Oroville: the North Fork Feather River, the West Branch of the North Fork Feather River, the Middle Fork Feather River, and the South Fork Feather River. Oroville Lake and its tributaries, together with the Thermalito Complex, support "warmwater" and "coldwater" recreational fisheries. Fish species of management concern include black bass, which contribute to the warmwater component of the fishery and anadromous salmonid and trout species, which contribute to the coldwater component. Both fisheries provide a high recreational value to the general public. Trophy programs and tournaments have been established in the area for both the salmonid and black bass angling fisheries.

California Department of Fish and Game (DFG) has been involved with fishery management activities in the Feather River watershed for over 100 years. In the 1960s, the DFG narrowed its focus and initiated fishery management activities within the FERC project boundary. These activities in the basin included fisheries studies, species introductions, fish stocking programs, habitat enhancement projects, and operation of the Feather River Hatchery. While habitat restoration efforts and fish stocking from the Feather River Hatchery have increased fish production and provided increased angling opportunities in Lake Oroville, management actions such as the introduction of exotic species and disease propagation through stocking may have affected fishery resources in project waters. Downstream of the Oroville facilities, runs of natural anadromous salmonids and other resident species are affected by water releases from the dam, diversion pools associated with the project, and the effects of the project on water quality in the Feather River (DWR, 2001). Potential impacts to natural fish populations upstream or downstream of Lake Oroville also may occur from fish stocked in Lake Oroville.

In 1994, FERC ordered the DWR to formulate and implement a fisheries management plan that would "promote a multi-species warmwater and coldwater fishery with the general goal of benefiting a diverse angling community" in Lake Oroville. DWR complied with the FERC orders by implementing salmon stocking and fish habitat improvement projects in Lake Oroville and submitting their fisheries management plan to FERC in February of 2000. This plan is currently under review by FERC. As a result of the 1994 FERC orders, DWR became involved with fisheries management activities. Since that time, DWR has stocked over 1.9 million salmon in Lake Oroville and expanded the Feather River Hatchery for Lake Oroville stocking. In 1999 alone, the Feather River Hatchery raised approximately 500,000 yearling Chinook salmon; 450,000 were stocked in Lake Oroville, 25,000 were stocked in the Thermalito Forebay, and the remainderwere stocked in reservoirs outside of the Oroville Area. Some fish tagged with reward tags have been documented downstream of Lake Oroville in the Feather River below the Fish Barrier Dam, which suggests the potential for interactions between the Lake Oroville and Feather River Fisheries (Eric See, DWR, pers. comm.). In addition, DWR has implemented a warmwater fish habitat enhancement project, involving the planting and anchoring of over 28,000 willow trees, and brush shelter construction (utilizing 6,400 used

Christmas trees, and several thousand manzanita and oak trees) on several locations in Lake Oroville to provide an additional microcover for protection of juvenile black bass.
Prior to the involvement of DWR in the fisheries management, DFG had conducted stocking experiments. In the 1970's and 1980's the DFG stocked rainbow trout and lake trout in Lake Oroville with varying degrees of success and eventually ceased stocking these fish (DWR 2001). Rainbow trout are still caught in Lake Oroville in low numbers. DFG also experimented during the 1980's with stocking of striped bass in the Thermalito Afterbay. Although the species did not develop into a large self-sustaining population, small numbers of striped bass are caught each year indicating a small reproducing population (Eric See, DWR, pers. comm.) Private fishing clubs also stocked Florida-strain largemouth bass.

2.0 Study Objective

This study plan is designed to address the following three issues and will:

- Evaluate fisheries management plans produced by resource agencies.
- Evaluate the effects of fisheries stocking and management practices on ESA listed fish species.
- Evaluate the success in meeting fisheries management goals that "promote a multispecies warmwater and coldwater fisheries that would benefit a diverse angling community" as defined by FERC in the current license, through the fisheries management programs implemented by DWR.
- Evaluate the interactions of the managed fisheries in the project area (Lake Oroville and the Oroville Facilities) with the fisheries and aquatic environments in adjacent areas (Lake Oroville's upstream tributaries, the OWA and the Feather River).

These issues will be addressed through a desktop study involving literature review and analysis of published data that may include fish and species distribution in Lake Oroville and associated project waters, catch statistics of the angling fishery, records of fish habitat enhancement projects, and Feather River Hatchery stocking records for Chinook salmon in Lake Oroville. The study plan will provide a conceptual basis for the development of protection, mitigation and enhancement measures (PM&Es).

3.0 Relationship to Relicensing/Need for the Study

Coldwater and warmwater fishing are important facets of recreation at the Lake Oroville project. The project-related lake fisheries may interact with the upstream tributary fisheries through interactions such as predation, competition for available food and habitat, disease transmission and genetic introgression. Additionally, components of the coldwater and warmwater reservoir fisheries have the potential to interact with ESA listed species in the Feather River. In order to evaluate the success of the Oroville operations' ability to meet the 1994 FERC mandate, it is necessary to identify current stocking goals and evaluate the conditions of the fishery. Under the current FERC license, DWR is required to develop and implement a fisheries management plan with the goal of protecting and promoting warm- and coldwater fisheries at Oroville. In order to provide

benefits to both types of fisheries at Lake Oroville, compliance with FERC orders regarding fisheries management plans related stocking goals should be evaluated.

Section 4.51 (f)(3) of 18 CFR requires reporting of certain types of information in the FERC Application for License for major hydropower projects, including a discussion of the fish, wildlife and botanical resources in the vicinity of the project. The discussion needs to identify the potential impacts on these resources, including a description of any anticipated continuing impact for on-going and future operations of the project. In addition to fulfilling these requirements, information developed in this study plan also may be used in determining appropriate protection, mitigation and enhancement (PM&E) measures or other management actions for the project.

4.0 Study Area

The proposed study area encompasses Lake Oroville, its upstream tributaries, the Thermalito Complex, and the Feather River. The upstream tributaries of Lake Oroville consist of four major tributaries: the North Fork Feather River, the West Branch of the North Fork Feather River, the Middle Fork Feather River, and the South Fork Feather River. The upstream extent of the study area extends to the first stream channel obstruction that limits upstream migration of salmonids. A previous investigation of tributary spawning potential has identified Miocene Dam on the West Branch of the North Fork Feather River, Curtain Falls on the Middle Fork Feather River, and Ponderosa Diversion Dam on the South Fork Feather River as impassable fish barriers, and Big Bend Dam on the North Fork Feather River as an impediment to upstream passage at all but the highest reservoir levels (DWR 1993). These barriers to fish passage will be re-evaluated under Task 1A of SP-F3.1 to confirm the upstream geographic scope of this study plan. The downstream extent of the study area in the Feather River extends to the confluence of the Yuba River. Within the Thermalito Complex, the study area includes the Thermalito Diversion Pool, Thermalito Afterbay, and Thermalito Forebay. Study plans approved by the Environmental Work Group define the limits of the study area. If initial study results indicate that the study area should be expanded or contracted, the Environmental Work Group will discuss the basis for change and revise the study area as appropriate.

5.0 General Approach

This work plan is designed as a desktop study to assemble and summarize information regarding fish stocking, fisheries management practices, and fish interactions. This study plan is based on literature review and will rely on existing information and on data collected and analyses conducted as part of other Oroville facilities FERC relicensing plans. Existing information to be utilized includes peer-reviewed articles, gray literature, technical reports, field surveys and data reports, creel census reports, federal or state agency reports, official fishery statistic reports, and stocking reports. This study plan is structured as a 3-task study and is organized into the following tasks. Task 1 of this study plan is designed to evaluate the potential effects of fisheries management activities on ESA listed fish species. This task will involve a review and evaluation of potential interactions of stocking and non-stocking related fish management activities with ESA listed species. Task 2 will identify the current stocking goals and evaluate the Oroville project's success at achieving those goals. Task 3 will identify fish species in Lake Oroville and its upstream tributaries and will utilize a literature review to identify and summarize potential interactions between the Lake Oroville and upstream tributary

fisheries. If initial study results indicate that the methods and tasks should be modified, the Environmental Work Group will discuss the basis for change and revise the study plans as appropriate.

In order to achieve task objectives of conceptually evaluating the effect of fisheries management activities on ESA listed species, the achievement of stocking goals, and the interactions between Lake Oroville and upstream tributary fisheries, information from many sources will be integrated and summarized. The literature review may include, but is not limited to, the following existing sources:

- DWR Lake Oroville Annual Reports of Fish Stocking and Fish Habitat Enhancements to FERC, 1994-1999 - Lake Oroville fishery management information, resident fish stocking data, resident fish species data, and fish habitat enhancement projects;
- DWR Lake Oroville 90-Day Fishery Reports to FERC, 1995-1999 - Lake Oroville fishery management information, resident fish species data, resident fish stocking data, fish habitat enhancement projects, and water temperature profiles;
- DWR Lake Oroville Fisheries Habitat Enhancement Plan, 1995 - Lake Oroville fish habitat and habitat enhancement information;
- DWR Lake Oroville Fishery Management Plan Progress Report, October 1993 - Lake Oroville fishery and tributary information;
- DWR Amended Recreation Plan for Lake Oroville State Recreation Area, 1993 - Lake Oroville fishery information;
- PG&E FERC relicensing proceedings and studies of North Fork Feather River projects - Including draft Poe Project License Application, existing Poe license with conditions; Rock Creek Cresta License and conditions. Information on tributary (North Fork Feather River) fish;
- DFG: An Evaluation of Fish Populations and Fisheries in the Post-Oroville Project Feather River, 1977;
- DFG Inland Fisheries Division - Information Leaflet No. 42, Warm Water Reservoir Fish Habitat Improvement Guide;
- DFG annual reports on fish habitat enhancement;
- Strategic Plan For Trout Management;
- DWR letters to FERC (4/16/01 & 7/13/00) - updates to FERC regarding Infectious hematopoietic necrosis (IHN) and its impact on Lake Oroville fishery management;
- DWR and DFG fish habitat enhancement projects;
- Other historic literature related to fishery management plans in the project waters or the Feather River; and
- Concurrent studies occurring as part of the Oroville Facilities FERC relicensing process.

Detailed Methodology and Analysis

Task 1—Evaluate the potential effects of fisheries management activities on ESA listed fish species

Task 1 is designed to provide a conceptual evaluation of the potential effects of fisheries management activities, including stocking and non-stocking management activities, on ESA listed species within the study area. The Feather River downstream of the Fish Barrier Dam is designated as critical habitat for the ESA listed fish species described below in Table 1. In addition to the existing information describing the

distribution of ESA listed fish species, data describing the distribution of ESA listed fish species will be collected under SP-F10.

Species	Run	ESA Status (Federal)
Oncorhynchus mykiss	Winter Steelhead	Threatened
Oncorhynchus tshawytscha	Spring-run Chinook Salmon	Threatened
Oncorhynchus tshawytscha	Fall-run Chinook Salmon	Candidate

Table 1. List of ESA listed fish species in the study area.

Lake Oroville and the Thermalito Forebay are stocked in order to maintain an attractive sport fishery. Stocked fish may potentially interact with ESA listed fish species in the Feather River, and one component of this evaluation is to characterize the types of potential effects of fish stocking on ESA listed species in the Feather River. Lake Oroville is stocked with both coldwater and warmwater fish species. From 1990-2000, the Lake Oroville coldwater fishery was managed for Chinook salmon (*Oncorhynchus tshawytscha*) and brown trout (*Salmo trutta*) (DWR 2000). Recent disease concerns, including the prevalence of infectious hematopoietic necrosis virus (IHN), have prompted changes in the stocking program at Lake Oroville. Due to their susceptibility to IHN, Chinook salmon and brown trout are not currently being stocked; however, stocking may resume in the future if IHN is eradicated. Beginning in 2002, coho salmon (*O. kisutch*) will be stocked as a replacement for Chinook salmon and brown trout in order to maintain an attractive coldwater fishery in Lake Oroville, as they are less susceptible to IHN. DFG manages the fishery with the primary objectives of producing trophy salmonids and providing a quality fishery characterized by high salmonid catch rates (DWR 2000). The coldwater fishery is sustained by hatchery stocking because natural recruitment to the Lake Oroville coldwater fishery is very low.

Lake Oroville's warmwater fishery is a self-sustaining fishery including four species of black bass (*Micropterus punctulatus, M. salmoides, M. dolomieui* and *M. coosae*), two species of sunfish (*Lepomis cyanellus* and *L. macrochirus*), two species of crappie (*Pomoxis nigromaculatus* and *P. annularis*), and two species of catfish, channel catfish (*Ictalurus punctatus*) and white catfish (*I. catus*). A small experimental plant of Florida strain largemouth bass occurred during the fall of 2000 (DWR 2001). This planting was designed to promote genetic enhancement of existing bass stocks and promote trophy fish production. The warmwater fishery in Lake Oroville is self-reproducing and therefore is not stocked in order to maintain a target number of fish, but rather to promote genetic enhancements of target fish. Spotted bass are considered to be the most significant component of the warmwater fishery in Lake Oroville, in terms of angler effort and regional economic impact (DWR 2001). The most abundant bass species in Lake Oroville is spotted bass, followed by largemouth, redeye, and smallmouth bass (DWR 2001). DFG manages the bass fishery in Lake Oroville with special angling regulations that stipulate the release of all bass between 12 and 15 inches in length (DWR 2001). Additionally, the catch rates of bass exceeding 12 inches at Lake Oroville are among the highest catch rates of any two-story California reservoir, making Lake Oroville one of the most popular bass fisheries in the state.

The Thermalito Forebay is managed by DFG as a put-and-take trout fishery, where rainbow trout and brook trout of approximately 1/2 pound are stocked biweekly (DWR 2001). Surplus inland Chinook salmon from Lake Oroville stocking efforts also have been stocked in the Thermalito Forebay in February of 2000 (DWR 2001). The Thermalito Forebay is the second most popular reservoir sport fishery of the Oroville Facilities (DWR 2001).

Task 1 is divided into two components to facilitate evaluation of potential effects of fisheries management on ESA listed species. The first component involves evaluating the potential effects of stocking-related sport fish management activities on ESA listed fish species, while the second involves evaluating the potential effects of non-stocking related sport fish management activities on ESA listed fish species.

Evaluate the potential effects of stocking-related sport fish management activities on ESA listed fish species in the Feather River. In order to provide a conceptual evaluation of the effects of stocking-related sport fish management activities on ESA listed fish species, stocking activities must be summarized. Lake Oroville and the Thermalito Forebay are the only water bodies that have ongoing stocking programs within the study area. Stocking activities for Lake Oroville and the Thermalito Forebay will be summarized from existing stocking reports, DWR and DFG reports, FERC orders related to fish stocking, and other existing literature including information listed under section 5.0 General Approach. The stocking summary will include the number, type, strain, and size of fish species stocked, along with the stocking date or frequency (biweekly from May through June, once annually, etc.).

Once the stocking activities in Lake Oroville and the Thermalito Forebay have been summarized, the stocked and/or managed sport fish species that potentially interact with ESA listed fish species will be identified and the nature of the interaction will be described. A literature review will be conducted to provide the information necessary to identify which fish species interact with ESA listed species and to describe the potential types of interactions. Identified potential interactions between stocked fish species and ESA listed fish species include predation, competition for food, competition for habitat, disease transmission, and genetic introgression. This list may be expanded if the literature review suggests that there are additional types of interactions between the fish species stocked in Lake Oroville and the Thermalito Forebay with the ESA listed species in the Feather River. The opportunity for physical interaction will also be considered as part of the conceptual evaluation. In other words, if a stocked fish species could interact with an ESA listed species, the opportunity for interaction (competition for habitat, for example) may depend on the physical proximity or the opportunity for transit to specific locations (i.e., from one water body to another) for potential interactions of the two fish species.

Fish health issues are one example of the potential interactions between stocked fish species and ESA listed fish species that will be considered in this task. As part of the task deliverable to be determined through the literature review, a list of potential diseases and/or pathogens that may be harmful to sturgeon, Chinook salmon and steelhead in Lake Oroville's upstream tributaries will be developed. Information from SP-F2 will provide descriptions of the physical and biological conditions and transmission mechanisms that are required by the diseases and/or pathogens identified in the literature review. Additionally, SP-F2 will also provide information about the following elements to address disease concerns with respect to management activities: (a) document the presence of disease in potential spawning and rearing areas; (b) summarize methods and

practices to reduce factors that increase the risk of disease transmission; (c) summarize fish health screening and transplant protocols which reduce the risk of disease transmission; (d) document the effects of diseases/pathogens on target species, including growth and survival; and (e) summarize knowledge gained from IHN and whirling disease monitoring or other disease/pathogen monitoring efforts. Other studies, management plans, and FERC projects that have addressed fish health issues such as whirling disease, IHN, or other diseases may be reviewed to further support the discussion.

This task consists of a review of existing information sources including scientific papers and texts focusing on fish ecology and fish interactions, reports or studies by federal and state agencies focused on fish interactions, and results of related Oroville Facilities FERC relicensing study plans. Other Oroville Facilities FERC relicensing study plans that are anticipated to provide information used in this task include:

- SP-F1 - macroinvertebrate functional groups present within the Oroville project area for evaluation of potential competition for food
- SP-F2 – fish disease types and transmission characteristics occurring in the study area for evaluation of the potential interactions of stocking and management practices on fish diseases
- SP-F3.2 – distribution of non-salmonid fish species in the Feather River below the Fish Barrier Dam to be used in the evaluation of potential interactions and non-salmonid fish species biological requirements and lifestage history to be used in the evaluation of potential interactions of competition for food and habitat
- SP-F3.1 – distribution of fish species within the Oroville reservoir, upstream tributaries up to the first fish barrier and the Thermalito Diversion Pool, Forebay and Afterbay to be used in the evaluation of potential interactions and information supplemental to SP-F3.2 (as required) regarding non-salmonid fish species biological requirements and lifestage history to be used in the evaluation of potential interactions of competition for food and habitat
- SP-F10 – distribution of salmonid fish species in the Feather River below the Fish Barrier Dam to be used in the evaluation of potential interactions and salmonid fish species biological requirements and lifestage history to be used in the evaluation of potential interactions of competition for food and habitat
- SP-F21 – predator distribution and prey base information to include in the evaluation of potential predation interactions
- SP-R13 – creel survey data to supplement fish distribution information and to evaluate stocking survival rates in the “put and take” stocking program

For example, life history and habitat requirements for non-salmonid fish species and salmonid fish species will be summarized in SP-F3.2, SP-F3.1 and SP-F10, respectively. SP-F3.2 (Task 2) and SP-F3.1 (Tasks 2A and 3A) will provide a review of the life history and habitat requirements of stocked fish which will include a summary of the habitat requirements of fish by species and lifestage (habitat types, water temperatures, water depth, water velocity, substrate, etc.); adult migration characteristics (timing, and water temperature and flow conditions); spawning characteristics (habitat availability, timing, and factors affecting timing and success such as substrate conditions and water temperatures); early development (factors affecting incubation and survival during incubation); juvenile rearing (water temperature, flow, substrate characteristics, refuges, shade, cover, food availability); juvenile movements (timing, prevalent flow, water temperature and other abiotic conditions, predation, stranding); and characteristics of the fish community (predators, prey, competitors) for

non-salmonid fish species. Various subtasks under Tasks 1, 2, 3 and 4 in SP-F10 will provide literature reviews of habitat requirements and life history characteristics for salmonids. SP-F2 will provide information regarding the occurrence and mechanisms of disease transmission. If required, the life history and habitat requirements from SP-F3.2 and SP-F10 and disease transmission information from SP-F2 may be supplemented with additional literature review to obtain additional information regarding community ecology or fish interactions.

Following is an example of the conceptual evaluation of the effects of stocked fish management activities on ESA listed fish species, which is presented in order to illustrate the types of factors that will be considered within the conceptual evaluation. One stocking activity that occurs in the Thermalito Forebay is the biweekly planting of catchable rainbow trout approximately 1/2-pound in size. Because rainbow trout and steelhead are the same species, potential interactions include competition for food, competition for habitat, disease transmission, and genetic introgression. If rainbow trout planted in the Thermalito Forebay reach the Feather River, there is the opportunity for interaction between the rainbow trout and the steelhead. The review of Thermalito Forebay stocking practices will summarize the number of fish planted, size of fish planted, frequency and time of year of planting, and strain of fish planted. Catch rates from creel surveys (from SP-R13) and other existing information and studies will be examined to determine the percentage of the planted rainbow trout that are caught as part of the put-and-take fishery. Not all planted rainbow trout will be caught in the put-and-take program, and the remaining rainbow trout may suffer from mortality caused by diseases present in Thermalito Forebay waters affecting rainbow trout, such as *C. shasta*. SP-F2 will provide information regarding the infection and mortality rates associated with *C. shasta* that will be used to estimate the influence of *C. shasta* on the remaining rainbow trout. Surviving rainbow trout have the potential to interact with Feather River steelhead through competition for food, competition for habitat, disease transmission, and genetic introgression if they are able to get to the Feather River. In one example, rainbow trout may get to the Feather River by passing through the Thermalito Pumping-Generating Plant, the Thermalito Afterbay, and the Thermalito Afterbay Outlet. In this scenario, the potential for the remaining rainbow trout population to interact with Feather River steelhead would depend upon the mortality rate of passage of rainbow trout through a facility like the Thermalito Pumping-Generating Plant, which will be evaluated based on information gathered in the literature review. Electrofishing data and creel survey information summarized in the literature review will describe the current rainbow trout population in the Thermalito Afterbay relative to that in the Thermalito Forebay resulting from the put-and-take fishery. Another factor considered in this example of the conceptual evaluation of the effects of stocking related sport fish management activities on ESA listed fish species in the Feather River is the ability of any remaining rainbow trout to exit the Thermalito Afterbay through the Thermalito Afterbay Outlet. The literature review will provide information regarding the mortality associated with passage of fish through structures such as the fish barrier structure at the Thermalito Afterbay Outlet. If remaining rainbow trout were able to successfully pass through the Thermalito Afterbay Outlet and arrive in the Feather River, opportunity would exist for interactions such as competition for food, competition for habitat, spread of disease, and genetic introgression. The literature review will provide information regarding these types of interactions and their potential effects on in-river steelhead. The information and process described above will form the basis for the conceptual evaluation, which will include a narrative explanation of the types and nature of the interactions that may occur between, in this case, rainbow trout and steelhead, as a product deliverable. The results of this conceptual evaluation will provide the foundation for potential development of changes in management practices, stocking practices, or development of potential PM&E measures.

Evaluate the potential effects of non-stocking related sport fish management activities on ESA listed fish species in the Feather River. Non-stocking related sport fish management activities include fish habitat enhancement activities and genetic enhancements. Habitat enhancement activities include the planting and anchoring of trees in several locations in Lake Oroville to provide additional cover for juvenile black bass. Genetic enhancements include the planting of Florida strain largemouth bass for trophy fish promotion. Both of these management actions potentially effect the resulting interactions of managed fisheries with ESA listed species.

Using the approach and methodology described above, a literature review will be conducted and will summarize existing information describing on-going non-stocking fisheries management activities including fish habitat enhancement activities and genetic enhancements in Lake Oroville, Lake Oroville's upstream tributaries, the Thermalito Forebay, the Thermalito Diversion Pool, and the Thermalito Afterbay. Once the non-stocking fisheries management activities in the study area have been summarized, a literature review will compile information regarding the non-stocking fisheries management activities that potentially affect ESA listed fish species in the Feather River. Information gathered in the literature review will be used to identify the non-stocking fisheries management activities that affect ESA listed fish species and will be used to provide a narrative explanation regarding the nature of the effects using the conceptual evaluation approach detailed above. The conceptual evaluation will provide the foundation for recommendations of changes in management practices, changes in stocking practices, or development of potential PM&E measures.

This portion of Task 1 also includes an evaluation of the potential effects of fisheries management in the Feather River on ESA listed species in the Feather River. Using existing information and a literature review, fish species in the Feather River that potentially interact with ESA listed fish species will be identified and the nature of the interaction described in a narrative report. This evaluation will include existing information used to document the fish species in the Feather River including SP-F3.2, SP-F10 and other existing sources of information listed above. Identified potential interactions between ESA listed fish species other fish species in the Feather River include predation, competition for food, competition for habitat, disease transmission, and genetic introgression. This list may be expanded if the literature review suggests that there are additional types of interactions between ESA listed species and other fish species in the Feather River that have not already been identified. Once the non-ESA listed fish species which potentially interact with ESA listed fish species in the Feather River have been identified, the management activities in place for the non-ESA listed fish species will be summarized though a review of fish management plans and other existing literature. An evaluation describing the potential effects of non-stocking fisheries management activities targeting non-ESA listed species on ESA listed species will be conceptually evaluated as described above. The conceptual evaluation will provide the foundation for the potential development of recommendations of changes in management practices, changes in stocking practices, or development of potential PM&E measures.

Task 2 – Evaluate the achievement of current stocking goals

Only two water bodies within the study area currently have active and ongoing stocking programs. Rainbow trout are stocked in the Thermalito Forebay, which is managed as a put-and-take fishery according to DFG return goals that have been established according to angler catch rate returns (i.e. a 50 percent return rate). The only other stocked reservoir within the study area is Lake Oroville, which is managed to include the components of both its coldwater (salmonids) and warmwater (black bass) fisheries.

The objective of this task is threefold: to review the existing stocking goals in the stocked waters of the project area (i.e. Lake Oroville and the Thermalito Forebay), to determine whether or not the prescribed goals are being met, and if they are not, to identify whether project operationally-related conditions are preventing the attainment of these goals (e.g. water surface elevation fluctuations, water temperature and flows).

Identify existing stocking goals: The first part of the task objective will be obtained through a review of fisheries management policies and procedures listed in fish stocking plans, management programs and the current FERC orders to identify the existing goals for each stocked water body and for each species of fish that is being planted within the study area. Stocking goals may vary, depending upon the management strategies that are specific to a particular body of water. Some examples of the various types of stocking goals that may be in place include: achieving specific angler catch rates, achieving a specified fish size at the time of catch, and planting a particular number of fish at a specified size. Stocking practices and management goals are frequently assessed through an analysis of the total number of fish that are stocked over a given period of time and angler catch rates for stocked fish. Additionally, because Lake Oroville is managed to include a trophy component in both its coldwater and warmwater fisheries, genetic enhancement/trophy fish promotion will also be considered as a component of this task.

As part of the provisions designed to meet existing fisheries management goals in the project waters associated with the Oroville Facilities, there are regulations in place that serve to promote the long-term achievement of these goals. For instance, DFG manages the bass fishery in Lake Oroville with special angling regulations that stipulate the release of all bass between 12 and 15 inches in length (DWR 2001). This provision ensures that sufficient numbers of large, mature fish remain in the lake to maintain a self-sustaining fishery, and enable fish to grow to a larger size that is desirable to anglers. As a result, the catch rates of bass exceeding 12 inches at Lake Oroville are among the highest catch rates of any two-story California reservoir, making Lake Oroville one of the most popular bass fisheries in the state (DWR 2001). Because of the popularity of Lake Oroville's bass fishery, it not only attracts local sport anglers but large numbers of bass tournament anglers as well. Comparatively, DFG manages Lake Oroville's coldwater fishery to include two distinct management objectives. These objectives are to produce trophy (>5 lbs.) salmonids and to provide a quality fishery characterized by high salmonid catch rates. The goals associated with each of the stocked water bodies (i.e. Thermalito Forebay and Lake Oroville) within the project area will provide a baseline to measure and the project's success at meeting it's current mandated stocking and fisheries management goals (e.g. numbers of fish stocked, angler catch rates for stocked fish).

The first part of Task 2 will review and identify the defined management goals and stocking practices that are associated with each of the stocked bodies of water within the study area. This information will be summarized by geographic area. Possible sources of information that will be used to identify and extract the stocking goals include but are not limited to:

- DWR Lake Oroville Annual Report of Fish Stocking and Fish Habitat Improvements, February 1999.
- DWR Lake Oroville 90-Day Fishery Reports to FERC, 1995-1999. These reports include Lake Oroville fishery management information, resident fish species data, resident fish stocking data, fish habitat enhancement projects, and water temperature profiles.

- DWR Lake Oroville Fishery Management Plan Progress Report, October 1993. This report contains Lake Oroville fishery and tributary information.
- DWR Amended Recreation Plan for Lake Oroville State Recreation Area, 1993. This report contains Lake Oroville fishery information.
- Federal Energy Regulatory Commission (FERC) Order 68, FERC 61, 358 - Issued September 1994.
- DWR Lake Oroville Fisheries Habitat Enhancement Plan, 1995. This plan contains Lake Oroville fish habitat and habitat enhancement information.
- Strategic Plan For Trout Management.

Evaluate achievement of stocking goals: The second part of the task objective involves determining whether the stocking goals for each of the stocked water bodies within the study area are being achieved. This evaluation will be conducted utilizing existing information and information on fish distribution, fish size, catch rates, etc. from SP-F3.1, SP-F3.2, SP-F10 and SP-R13. This will be accomplished by comparing existing fisheries management goals to documented fishery conditions in the stocked water bodies within the study area, as a means of determining the level of success that has been achieved in meeting those management goals. Stocking activities for Lake Oroville and the Thermalito Forebay will be summarized from existing stocking reports, DWR and DFG reports, FERC orders related to fish stocking, and other existing literature including information listed under section 5.0 General Approach. The stocking summary will include the number, type, strain, and size of fish species stocked, along with the stocking date or frequency (biweekly from May through June, once annually, etc.). Other types of information that may be summarized in order to determine whether or not the stocking goals are being achieved include fish size distribution, angler catch rates and other pertinent data.

The information required for completion of this part of Task 2 will be obtained through a review and summary of creel census data, stocking reports and other fisheries surveys. This information will be synthesized by geographic area. In order to meet this part of the task objective, the following sources of information may be used during the review:

- DWR Lake Oroville Annual Reports of Fish Stocking and Fish Habitat Enhancements to FERC, 1994-1999 - Lake Oroville fishery management information, resident fish stocking data, resident fish species data, and fish habitat enhancement projects.
- SP-F3.1, Evaluation of Project Effects on Fish and Their Habitat within Lake Oroville, its Upstream Tributaries, the Thermalito Complex, and the Oroville Wildlife Area will supply information to Task 2 of SP-F5/7 regarding fish distribution and species composition.
- DFG: An Evaluation of Fish Populations and Fisheries in the Post-Oroville Project Feather River, 1977.
- DFG Inland Fisheries Division - Information Leaflet No. 42, Warm Water Reservoir Fish Habitat Improvement Guide.
- DFG annual reports on fish habitat enhancement.
- DFG paper on the Growth and Contribution to the Fishery of Chinook Salmon at Lake Oroville, California, 1999.

Identification of potential project operations influencing ability to meet stocking goals: The third part of the task objective is contingent upon the results of the first two task components and would only be conducted

if it is determined that stocking goals are not being met. In that case, this part of the task would perform a conceptual evaluation of the potential effects of project operations on the ability to meet the stocking goals based on the results of other fisheries studies.

The information and processes described above will form the basis for the conceptual evaluation, which will include a narrative explanation of the types of project operations which may influence the ability to meet stocking goals, in this case for Chinook salmon, as a product deliverable. The conceptual evaluation will provide the foundation for the development of recommendations of changes in operations, management practices, stocking practices or goals, as well as for the development of potential PM&E measures.

Task 3 - Evaluate the interactions between the Lake Oroville fishery and upstream tributary fisheries

Task 3 is designed to provide a conceptual evaluation of the interactions between fish species in Lake Oroville and fish species in Lake Oroville's upstream tributaries. Lake Oroville includes the area below Lake Oroville's high water mark and supports a variety of warmwater and coldwater fish species, as described in the introduction to Task 1. The fisheries in the tributary reaches between Lake Oroville's high water mark and the first fish passage barrier may differ from the fisheries below Lake Oroville's high water mark because the upstream reaches are not seasonally inundated. Generally the upstream tributaries above Lake Oroville's high water mark to the first fish passage barrier are managed for coldwater fish species, although flow and water temperature components of the habitat are not controlled by the Oroville Facilities. Upstream of the high water mark of Lake Oroville, the tributaries support a typical California foothill stream-dwelling fish assemblage, which includes rainbow trout, brown trout, several black bass species such as smallmouth bass, spotted bass, largemouth bass, and redeye bass, hardhead, pikeminnow, and Sacramento sucker (E. See, pers. comm.2002).

The potential for interaction between fish species in Lake Oroville and fish species in the upstream tributaries will be evaluated conceptually using the literature review-based approach described in Task 1. Fish species composition information for Lake Oroville will be provided by Task 2A of SP-F3.1. Data describing the fish species composition in Lake Oroville's upstream tributaries will be provided by a literature review and through field data collection (snorkel surveys) occurring in Task 1B of SP-F3.1. Once the fish species composition in Lake Oroville and Lake Oroville's upstream tributaries has been summarized, the Lake Oroville fish species that potentially interact with upstream tributary fish species will be identified and the nature of the interaction will be described. A literature review will be conducted to provide the information necessary to identify which of the Lake Oroville fish species interact with upstream tributary fish species and to describe the type of interaction. Identified potential interactions between Lake Oroville fish species and upstream tributary fish species include predation, competition for food, competition for habitat, disease transmission, and genetic introgression. This list may be expanded if the literature review suggests that there are additional types of interactions that merit inclusion.

This task consists of a review of existing information sources including scientific papers and texts focusing on fish ecology and fish interactions, reports or studies by federal and state agencies focused on fish interactions, and results of related Oroville Facilities FERC relicensing study plans. Other Oroville Facilities FERC relicensing study plans that are anticipated to provide information used in this task include:

- SP-F1 - macroinvertebrate functional groups present within the Oroville project area for evaluation of potential competition for food
- SP-F2 – fish disease types and transmission characteristics occurring in the study area for evaluation of the potential interactions of stocking and management practices on fish diseases
- SP-F3.2 –non-salmonid fish species biological requirements and lifestage history to be used in the evaluation of potential interactions of competition for food and habitat
- SP-F3.1 – distribution of fish species within the Oroville reservoir and the upstream tributaries up to the first fish migration barrier to be used in the evaluation of potential interactions and information supplemental to SP-F3.2 (as required) regarding non-salmonid fish species biological requirements and lifestage history to be used in the evaluation of potential interactions of competition for food and habitat
- SP-F10 –salmonid fish species biological requirements and lifestage history to be used in the evaluation of potential interactions of competition for food and habitat
- SP-F21 – predator distribution and prey base information to include in the evaluation of potential predation interactions
- SP-R13 – creel survey data to supplement fish distribution information

An evaluation describing the types and nature of the interactions between fish species in Lake Oroville and fish species in the upstream tributaries identified through the literature review will be conducted using the conceptual evaluation approach described in Task 1. The conceptual evaluation will provide the foundation for the development of potential recommendations of changes in management practices, changes in stocking practices, or development of potential PM&E measures.

6.0 Results and Products/Deliverables

Results

Results will be organized following the task headings. Each task will include a narrative of the relevant findings as well as tables, figures and maps summarizing the key points. The results of the four sections will be integrated to evaluate potential project effects on fish habitat and resultant impacts on fish populations. The anticipated maps, graphical representation of reviewed data (e.g., charts, and graphs) and summary figures and tables include:

Products/Deliverables

- A summary of stocking activities in Lake Oroville and Thermalito Forebay (Task 1);
- A literature review will be conducted to provide the information necessary to identify which fish species interact with ESA listed species and to describe the potential types of interactions. This task consists of a review of existing information sources including scientific papers and texts focusing on fish ecology and fish interactions, reports or studies by federal and state agencies focused on fish interactions, and results of related Oroville Facilities FERC relicensing study plans. Non-stocking fisheries management activities in the study area will also be summarized and the literature review will compile information regarding the non-stocking fisheries management activities that potentially affect ESA listed fish species in the Feather River. This review will summarize existing information

describing on-going non-stocking fisheries management activities including fish habitat enhancement activities, fishing regulations (take limits, etc.), and genetic enhancements in Lake Oroville, Lake Oroville's upstream tributaries, the Thermalito Forebay, the Thermalito Diversion Pool, and the Thermalito Afterbay (Task 1);

- Listing and evaluation of all relevant resource agency management plans;
- A narrative summary describing the conceptual evaluation of the effects of stocked fish management activities on ESA listed fish species will be provided (Task 1). This will include a literature review of information regarding the mortality associated with passage of fish through structures. Once the non-ESA listed fish species that potentially interact with ESA listed fish species in the Feather River have been identified, the management activities (take limits, etc.) in place for the non-ESA listed fish species will be summarized though a review of fishing regulations, fish management plans, and other existing literature. An evaluation describing the potential effects of non-stocking fisheries management activities targeting non-ESA listed species on ESA listed species will be conceptually evaluated as described in Task 1;
- Review and identify the defined management goals and stocking practices that are associated with each of the stocked bodies of water within the study area. This information will be summarized by geographic area. (Task 2);
- Through comparison of existing fisheries management goals to documented fishery conditions in the stocked water bodies within the study area, a summary report will be provided to assess the level of success that has been achieved in meeting management goals (Task 2);
- A narrative summary describing the conceptual evaluation of the potential effects of project operations on the ability to meet the stocking goals may be provided if it is determined that stocking goals are not being met (Task 2);
- A literature review will be conducted to provide the information necessary to identify which of the Lake Oroville fish species interact with upstream tributary fish species and to describe the type of interaction (Task 3);
- A narrative summary describing the conceptual evaluation of the potential for interaction between fish species in Lake Oroville and fish species in the upstream tributaries will be evaluated conceptually using the literature review-based approach described in Task 1 (Task 3).

7.0 Coordination and Implementation Strategy

Coordination with Other Resource Areas/Studies

An evaluation of the fisheries management program to attain sustainable multispecies fisheries will require coordination with other relicensing studies. Information gathered during the studies listed below is relevant to this fisheries management study and will be required to assess the impact of current and future management programs, actions, and requirements to fisheries resources in the study area.

- *SP-F1 - Evaluation of Project Effects on Non-fish Aquatic Resources:* SP-F1 will provide SP-F5/7 with information about the macroinvertebrate functional groups present within the Oroville project area for evaluation of potential competition for food.

- *SP-F2 – Evaluation of Project Effects on Fish Diseases:* SP-F2 will provide SP-F5/7 with information about fish disease types and transmission characteristics occurring in the study area for evaluation of the potential interactions of stocking and management practices on fish diseases. Information from SP-F2 will include infection and mortality rates associated with *C. shasta* that will be used to estimate the influence of *C. shasta* on the remaining rainbow trout (Task 1).

- *SP-F3.1 - Evaluation of Project Effects on Fish Habitat and their Habitat within Lake Oroville, its Upstream Tributaries, the Thermalito Complex, and the Oroville Wildlife Area:* Task 1A of SP-F3.1 will provide SP-F5/7 with information about the existing barriers to fish passage to provide confirmation of the upstream geographic scope to the study plan. Task 2A of SP-F3.1 will also provide information for Task 1 and Task 2 of SP-F5/7 regarding the composition and distribution of fish species within the Oroville reservoir, upstream tributaries up to the first fish barrier and the Thermalito Diversion Pool, Forebay and Afterbay.

- *SP-F3.2—Evaluation of Project Effects on Non-salmonid Fish in the Feather River Downstream of the Thermalito Diversion Dam:* SP-F3.2 will provide information to SP-F5/7 on the distribution of non-salmonid fish species in the Feather River below the Fish Barrier Dam to be used in the evaluation of potential interactions and non-salmonid fish species biological requirements and lifestage history. The information from this task needed to evaluate potential inter-specific competition and predation at the project.

- *SP-F10 - Project Impacts on Salmonid Fish and Their Habitat:* SP-F10 will provide SP-F5/7 with information describing the distribution of ESA listed fish species. This will include the distribution of salmonid fish species in the Feather River below the Fish Barrier Dam to be used in the evaluation of potential interactions and salmonid fish species biological requirements and lifestage history to be used in the evaluation of potential interactions of competition for food and habitat.

- *SP-F21 – Project Effects on Predation of Feather River Juvenile Anadromous Salmonids:* SP-F21 will provide SP-F5/7 with information on predator distribution and prey base information to include in the evaluation of potential predation interactions.

- *SP-R13 – Recreation Surveys:* SP-R13 will provide SP-F5/7 with information from creel survey data to supplement fish distribution information and to evaluate catch rates and stocking survival rates in the “put and take” stocking program.

Issues, Concerns, Comments Tracking and/or Regulatory Compliance Requirements

This study fully or partially addresses the following Stakeholder issues:

Stakeholder issues fully addressed by SP-F5/7 Evaluation of Fisheries Management on Project Fisheries

Issue	Description
FE27	Land-locked salmon fishery; also in SP-F3.1
FE100	Create more habitat for the black bass and warm water fishes such as spawning beds or boxes; spawning plates or stationary buoy cables

Source: NEPA Scoping Document 1 and CEQA Notice of Preparation, DWR 2001.

Stakeholder issues partially addressed by SP-F5/7 Evaluation of Fisheries Management on Project Fisheries

Issue	Description
FE15	Develop and maintain a balanced fishery
FE19	Rearing bass (plants) for recreational and trophy fishery
FE25	Interaction of lake fishery with tributaries fisheries
FE47	Desire to see a balanced fishery
FE52	Facility operations and impact – on bass fishery and spawning activities at Afterbay (protect and enhance bass fishery)
FE58	Improve and protect habitat for designated emphasis and harvest species. Identify and evaluate potential conflicts among project effects and management actions for protected and sensitive species
FE63	Coordination between re-licensing effort and existing management plans in and out of the project boundary
FE70	Potential to reopen salmon fishery above Highway 70 bridge; also addressed SP-F10
FE73	Responsible management by resource agencies
FE79	Oroville Reservoir provides substantial recreational fishing opportunity for both black bass and Chinook salmon fisheries. Hatchery planting practices for Chinook salmon could be impacting habitat conditions and the population dynamics of black bass and other species, thus impairing socioeconomic use. Fishing interests want to improve the reservoir fishery so that it becomes a more popular recreational destination as a result of a successful balanced species reservoir fishery. An appropriate balance of species should exist in the reservoir to support environmental sustainability and long-term maintenance of a healthy ecosystem.
FE 81	Currently some of the species of fish commonly found in Lake Oroville are also found in the Poe reach of the North Fork Feather River. Maximum water temperatures in the Poe reach often exceed 20 C (68 F), making management of the Poe reach as a cold water fishery difficult. There is an interest in determining the interaction of the Lake Oroville fishery with the Poe reach fishery. And identifying measures that can be taken to maintain the Poe reach as a cold water fishery; also addressed in SP-3.1, SP-W6
FE91	Current condition of habitat potentially impacted by project and alternatives to conserve or enhance anadromous salmonids; also addressed in SP-F10

Issue	Description
FE92	Priority of salmonid habitat conservation in current operating criteria and various operating agreements; also addressed in SP-F10

Source: NEPA Scoping Document 1 and CEQA Notice of Preparation, DWR 2001.

8.0 Study Schedule

	Timing/Deadlines	
Task	**Task deliverables in SP-F5/7**	**Final Report**
1	Summary of stocking activities;	Three months following completion of relevant data collection from supporting FERC relicensing study plans
	Literature review identifying which fish species interact with ESA listed species and descriptions of the potential types of interactions;	
	Literature review and narrative describing the conceptual evaluation of the effects of stocked fish management activities on ESA listed fish species will be provided;	
2	Narrative summary identifying defined management goals and stocking practices;	Three months following completion of relevant data collection from supporting FERC relicensing study plans
	Summary report that will compare existing fisheries management goals to documented fishery conditions in the stocked water bodies and assess the level of success that has been achieved in meeting management goals;	
	If necessary, a narrative summary describing the conceptual evaluation of the potential effects of project operations on the ability to meet the stocking goals;	
3	A literature review identifying which of the Lake Oroville fish species interact with upstream tributary fish species and descriptions of the type of interactions;	Three months following completion of relevant data collection from supporting FERC relicensing study plans
	Literature review and narrative summary describing the conceptual evaluation of the potential for interaction between fish species in Lake Oroville and fish species in the upstream tributaries;	

9.0 References

A complete list of references used in the completion of the study will be part of the summary report. The references cited in the present plan are listed below.

DWR. 2001. Initial Information Package, Relicensing of the Oroville Facilities, January 2001.

DWR. 2000. 1999 Lake Oroville Annual Report of Fish Stocking and Fish Habitat Improvements, February 2000.

DWR Environmental Services Office. October 1993. Lake Oroville Fisheries Management Plan. Progress Report.